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Contents

Abstract

Transonic steady- and unsteady-pressure tests have been conducted on a large elastic wing. The wing has a supercritical airfoil, a full-span aspect ratio of 10.3, a leading-edge sweepback angle of 28.8°, and two inboard and one outboard trailing-edge control surfaces. Only the outboard control surface was deflected statically and dynamically to generate steady and unsteady flow over the wing. This report presents the unsteady-surface-pressure and dynamic-deflection measurements of this elastic wing, in tabulated form, to permit correlations of the experimental data with theoretical predictions.

Introduction

At the NASA Langley Research Center, progress continues on a program to obtain measured unsteady pressures on several different wing configurations (refs. 1–3). The goal of this program is to generate an extensive data base of measured unsteady pressures for use in evaluating the accuracy of theoretical computational transonic aerodynamic programs. Initially, all the wing models that were tested were made as rigid as possible to minimize wing structural deformations and thereby maintain simple basic comparisons with the transonic aerodynamic programs. Recently, a flexible wing configuration was tested as part of this pressure measurement program. The flexible wing construction is similar to that of actual aircraft wings and should provide more realistic measured data for comparison with the results from the advanced transonic aerodynamic programs including the effects of aeroelastic deformations in the computational process.

This elastic wing configuration, known as the Drones for Aerodynamic and Structural Testing Aeroelastic Research Wing-2 (DAST ARW-2, ref. 4), has a full-span aspect ratio of 10.3 (excluding the area of the wing trailing-edge extension), a leading-edge sweepback angle of 28.8°, and a supercritical airfoil. The wing has three hydraulically actuated trailing-edge control surfaces and is instrumented with unsteady-pressure gages, making it extremely useful to the present unsteady-pressure-measurement program. The two inboard control surfaces were held fixed while the outboard control surface was oscillated to create the unsteady pressures. This report is one of a series of reports documenting the data acquired on the DAST ARW-2 (refs. 5–9).

The purpose of this report is to document, for future use, the measured unsteady-pressure and wing-deflection data results from an elastic wing configuration tested in the Langley Transonic Dynamics Tunnel (TDT). All pressure results are tabulated and presented in pressure-coefficient form.

Symbols

ACC MAG	magnitude of wing accelerometer signal, G units
AMPL	amplitude of oscillations, deg
b	semichord at $y = 0$, in. (22.12 in.)
CP	pressure coefficient, $(p - P)/q$
CPSTAR	critical pressure coefficient
DELTA CP	lifting-surface pressure coefficient, lower surface CP − Upper surface CP
f	frequency, Hz
G	$= \ddot{z}/g$
g	gravity constant, 386.088 in/sec^2
H	stagnation pressure, psf
K	reduced frequency, $\frac{b\omega}{V}$
MACH	free-stream Mach number
P	free-stream static pressure, psf
p	local static pressure at any point on wing surface, psf
q	free-stream dynamic pressure, psf (Q in computer-generated tables)
RN	Reynolds number based on average chord of 24.812 in.
V	free-stream velocity, in/sec
X	streamwise distance measured from wing local leading edge, in.

X/c	fraction of local-chord location (X/C in computer-generated tables and figures)
x	streamwise coordinate, in.
y	spanwise coordinate, in.
z	wing vertical deflection amplitude, in.
$\ddot{z}$	vertical acceleration, in/sec^2
α	wing angle of attack, positive for leading edge up, deg (ALPHA in computer-generated tables)
γ	ratio of specific heat at constant pressure to specific heat at constant volume (GAMMA in computer-generated tables)
δ	control-surface angle about hinge line, positive for trailing edge down, deg (DELTA in computer-generated tables)
η	fraction of wing semispan (ETA in computer-generated tables)
ω	oscillation frequency, rad/sec

Wind Tunnel Model

General

An elastic semispan wing model is described herein. This model consisted of the right wing panel from the Drones for Aerodynamic and Structural Testing Aeroelastic Research Wing-2 (DAST ARW-2) drone flight vehicle and a rigid half-body fuselage. Both the fuselage and the wing were mounted on a remotely controlled turntable mechanism located on the tunnel sidewall. The turntable was used to adjust the model angle of attack. A photograph, looking upstream, of the complete model mounted in the tunnel is shown in figure 1. The location of the sidewall turntable and its relationship to the wing and fuselage are shown in figure 2. For all the tests contained in this report, no boundary-layer trips were used; the boundary-layer transition on the wing was left free.

Fuselage Geometry and Construction

The geometric shape of the fuselage is shown in figure 2. Fuselage coordinates and further details about the structure are given in reference 8. The rigid half-body fuselage was used primarily to place the wing outside the wind tunnel wall boundary layer. The fuselage had a semicircular cross section. The nose and tail fuselage sections were made shorter than the actual flight fuselage. However, the center section of the fuselage was made very similar to the flight fuselage in both diameter and wing location to provide flow around the inboard section of the wing similar to that expected to occur on the flight vehicle. This fuselage shape represents that of a typical transport aircraft.

Wing Geometry, Construction, and Structural Properties

The elastic wing had a full-span aspect ratio of 10.3 (excluding the area of the wing trailing-edge extension) with a leading-edge sweepback angle of 28.8°. The planform geometry of the wing is presented in figure 3. The wing was equipped with three hydraulically actuated control surfaces, two inboard and one outboard. Their locations are also shown in figure 3. Only the outboard surface was deflected statically and dynamically during the pressure-measurement tests while both of the inboard surfaces were held fixed at 0° in relation to the wing surface. The outboard surface hinge line was located at 77 percent of the local chord.

The wing contour was the desired shape for a loaded wing associated with straight and level flight of a vehicle at a cruise Mach number of 0.8 and at an altitude of 46 800 ft with a lift coefficient of 0.53. However, an elastic wing will deform to a different shape, known as the jig shape, if all aerodynamic loads and vehicle weight loads are removed. The present wing configuration was fabricated to a set of calculated jig shape coordinates referred to as the design airfoil coordinates. Design coordinates and the measured coordinates from the actual wing cantilevered at the root chord are available from table 4 of reference 8. A detailed description of the wing construction, including how the calculated jig shape was determined, is found in reference 8. Also, reference 8 contains a detailed description of the structural properties of this elastic wing along with a structural finite-element model.

Instrumentation

The locations of the wing instrumentation are shown in figure 3. The primary instrumentation consisted of 182 pressure transducers and 10 accelerometers. In addition, strain gage bridges were located near the wing root to measure bending moments. A differential pressure gage was mounted in each supply line to the hydraulic actuator of each control surface to measure hinge moments. Small potentiometers were used to measure the control surface angular displacement. The model angle of attack was measured by a servo accelerometer that was mounted near the wing root.

Both steady and unsteady surface pressures were obtained with differential pressure transducers referenced to the static pressure of the tunnel. Streamwise rows of upper- and lower-surface orifices were located at six span stations. The wing location of these orifices is given in table 1. Steady pressures were measured at all six span stations. Unsteady pressures were measured on only the three outermost span stations. Surface orifices were connected to pressure transducers by matched tubes (ref. 10) having an inner diameter of 0.040 in. and a length of 18 in. To determine the wind-on tube transfer functions that are needed to correct the unsteady-pressure data from these matched-tube transducers, simultaneous measurements were also obtained from a row of in situ transducers (see fig. 3) mounted on the wing upper surface parallel to the fifth row of surface orifices. Based upon the manufacturer's specifications, the unsteady-pressure transducers used are accurate to within 0.038 psi.

The 10 accelerometers were used to determine the wing dynamic deflections. The accelerometer locations are shown in figure 3 and presented in table 2. The accelerometers were mounted in the wing approximately halfway between the upper and lower surfaces.

Wind Tunnel

The tests described in this report were conducted in the Langley Transonic Dynamics Tunnel (TDT). The TDT is a closed-circuit, continuous-flow tunnel that has a 16-ft square test section with cropped corners and with slots in all four walls. Mach number and dynamic pressure can be varied simultaneously or independently, with either air or a heavy gas used as a test medium. A heavy gas was used as the medium for all the tests contained in this report.

Data Acquisition and Reduction

All data from the model instrumentation were acquired with the TDT real-time data-acquisition system (ref. 11). The pressure measurements were acquired with an electronically scanned pressure (ESP) system (ref. 12). The ESP system is a sequential, digital pressure sampling equivalent to a mechanical scanivalve. The pressure data were digitized in real time at 250 samples per second and written on magnetic tape for later analysis. Unsteady pressures were measured for 90 ESP pressure transducers and 7 in situ pressure transducers. The accelerometer and control surface position data were acquired simultaneously, digitized in real time at 1000 samples per second, and written on magnetic tape for later analysis.

All dynamic-data time histories were recorded for a minimum of 50 cycles of outboard control surface oscillation. The time histories were converted into engineering units before harmonic analysis. Discrete Fourier transforms were taken of these time histories to provide the mean value, the magnitude, and the phase angle at the frequency of the oscillating control surface for the control surface potentiometer and each pressure transducer and accelerometer. Phase angles for the pressure transducers and accelerometers were defined relative to the motion of the oscillating control surface. A phase angle is positive when a gage's oscillatory signal leads the motion of the control surface.

Before the unsteady pressures are referenced to the motion of the oscillatory control surface, their phases must be corrected to account for time lags because of the sequential sampling of channels and the finite time required for a signal to propagate from the surface to the transducer through the 18-in-long tube. The phase correction was applied in a two-step process. First, the unsteady-pressure phases were adjusted to account for both the sequential sampling time lag and a measured wind-off tube propagation time lag. The combined phase correction ranged from 0.0087 deg/Hz to 1.1 deg/Hz. A wind-on tube transfer function was then determined by comparing the phase angles measured on the row of in situ transducers with the phase angles measured on the corresponding matched-tube transducers. The difference between the phase angles was plotted as a function of local Mach number and a straight-line least-squares fit was calculated. A different wind-on tube transfer function was calculated for each variation of free-stream dynamic pressure or control surface oscillation frequency. This resulted in a total of six different transfer functions being calculated because data were taken at two different dynamic pressures ($q = 100$ and 200 psf) and three different frequencies ($f = 5$, 15, and 20 Hz). The phase correction ranged from 5.2° to 40°. The wind-on tube transfer functions were applied to all the unsteady-pressure data as a function of free-stream dynamic pressure, control surface oscillation frequency, and local Mach number. A limited amount of unsteady-pressure data were taken at a free-stream dynamic pressure of 105 psf and, for correction purposes, were treated the same as the data acquired at $q = 100$ psf.

To determine the wing dynamic deflection, the magnitude of the accelerometer signal is used. The magnitude, which is in G units, is converted to a wing vertical deflection with the formula

$$z = \frac{\text{Magnitude} \cdot g}{(2\pi f)^2}$$

where f is the frequency of the outboard control surface oscillation and z is the wing vertical deflection amplitude in inches.

Presentation of Dynamic Data

A summary of the test conditions is presented in table 3 for convenience in identifying and locating a desired set of dynamic data. Data were obtained for multiple values of Mach number and dynamic pressure shown in figure 4. The Reynolds number (based on the average chord) varied from 2.4 to 1.8 million at Mach numbers of 0.6 to 0.85, respectively, at a dynamic pressure of 100 psf. Model parameter variations included an angle of attack of 0° and 2° and dynamic control-surface deflection amplitudes of 1°, 2°, and 3°. The data presented in the following sections are available in electronic form from the authors.

Surface-Pressure Measurements

The surface-pressure measurements are given in coefficient form in table 4. Each test condition is identified by a point number that is located in the first column of table 3 and in the upper left-hand corner of each page of table 4. Given at the top of table 4 for each test condition are three lines listing the wind tunnel and model parameters determined at the time the data were acquired. Underneath, labelled as "ANALYZED VALUES," are the outboard control-surface mean angle (MEAN), amplitude of oscillation (AMPL), OSCILLATION FREQUENCY, and reduced frequency (K) as determined by analyzing the outboard control-surface potentiometer data using a discrete Fourier transform as previously described. The "ANALYZED VALUES" of control-surface position and frequency do not precisely match the values determined when the data were recorded (listed on the line above) because a much longer time-record length was used when post-processing the data, resulting in slightly different but more accurate values. Next given in table 4 for each test condition are the fractional span location of the transducer row (ETA), the fraction of local-chord location (X/C), the upper-surface mean pressure coefficient (UPPER CP MEAN), the upper-surface harmonic pressure magnitude and phase angle (UPPER CP MAGNITUDE and UPPER CP PHASE), the lower-surface mean pressure coefficient (LOWER CP MEAN), the lower-surface harmonic pressure magnitude and phase angle (LOWER CP MAGNITUDE and LOWER CP PHASE), the difference or lifting-surface mean pressure coefficient (DELTA CP MEAN), and the difference or lifting-surface harmonic pressure magnitude and phase angle (DELTA CP MAGNITUDE and DELTA CP PHASE). These values are listed for each of the three different streamwise rows of pressure transducers at which model unsteady-pressure measurements were taken. The data for $\eta = 0.875$, listed near the bottom of the table, are from the in situ transducers. The data for $\eta = 0.981$, listed at the bottom of the table, are for a lower-surface transducer on the sixth row of surface orifices ($\eta = 0.972$) for which the spanwise location was moved to avoid interference with internal wing components.

Wing Deflections

The wing dynamic deflection measurements are given in table 5. Each test condition is identified by a point number that is located in the first column of table 3 and in the upper left-hand corner of each page of table 5. Given at the top of table 5, as in table 4, are four lines listing the wind tunnel and model parameters. Next given are the accelerometer's position in x and y (X and Y), the calculated wing vertical deflection amplitude in inches (DEFLECTION), the phase angle of the accelerometer signal in degrees (PHASE), and the magnitude of the accelerometer signal in G units (ACC MAG).

Concluding Remarks

Subsonic and transonic unsteady-pressure and dynamic-wing-deflection measurement results from tests conducted in the Langley Transonic Dynamic Tunnel on a large elastic wing model have been presented. No discussion of the data was included. The wing has a supercritical airfoil, a full-span aspect ratio of 10.3, and a sweepback angle of 28.8°. These experimental results are intended to aid in the development and validation of transonic flow theories.

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September 12, 1991

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Table 1. Location of Static- and Unsteady-Pressure Orifices and In Situ Transducers

Chord number	1	2	3	[a]4	[a]5	[a]6	[b]7
Semispan, in.	31.25	54.25	68.25	80.50	99.20	110.75	99.70
Percent of semispan	27.4	47.6	59.9	70.7	87.1	97.2	87.5
Local chord, in.	30.900	22.571	20.241	18.202	15.090	13.167	15.006
x value at leading edge, in.	17.172	29.811	37.505	44.236	54.512	60.859	54.787
Upper chordwise location: (X/c)/Distance from local leading edge in inches							
	0.025/0.773	0.025/0.565	0.025/0.506	0.025/0.455	0.025/0.377	0.025/0.329	
	.078/2.411	.088/1.987	.088/1.781	.087/1.584	.084/1.268	.092/1.211	
	.131/4.048	.151/3.409	.151/3.056	.148/2.694	.143/2.158	.162/2.107	0.143/2.146
	.184/5.686	.215/4.853	.214/4.331	.209/3.804	.202/3.048	.227/2.989	.202/3.031
	.247/7.633	.292/6.591	.290/5.869	.294/5.352	.301/4.542	.294/3.871	.301/4.517
	.331/10.228	.351/7.923	.348/7.043	.350/6.371	.354/5.342	.362/4.767	
	.415/12.824	.409/9.232	.406/8.217	.407/7.408	.407/6.142	.430/5.662	.407/6.108
	.499/15.419	.468/10.564	.464/9.391	.463/8.428	.460/6.941	.497/6.544	
	.561/17.335	.526/11.873	.522/10.565	.519/9.447	.513/7.741	.565/7.440	.513/7.698
	.621/19.189	.585/13.204	.581/11.759	.579/10.539	.566/8.541	.632/8.322	
	.682/21.074	.658/14.852	.654/13.237	.659/11.995	.680/10.261	.700/9.217	.680/10.20
	.736/22.743	.739/16.680	.735/14.877	.739/13.451	.742/11.197	.767/10.099	
	.809/24.998	.821/18.531	.817/16.536	.819/14.908	.830/12.525	.835/10.995	.830/12.45
	.884/27.316	.902/20.359	.899/18.196	.899/16.364	.910/13.732	.902/11.877	
	.930/28.737	.990/22.346	.990/20.038	.990/18.020	.990/14.939	.990/13.036	
	.990/30.591						
Lower chordwise location: (X/c)/Distance from local leading edge in inches							
	0.025/0.773	0.025/0.565	0.025/0.506	0.025/0.455	0.025/0.377	0.025/0.329	
	.078/2.411	.088/1.987	.088/1.781	.087/1.584	.084/1.268	.092/1.211	
	.131/4.048	.151/3.409	.151/3.056	.148/2.694	.143/2.158	[c].126/1.659	
	.184/5.686	.215/4.853	.214/4.331	.209/3.804	.202/3.048	.227/2.989	
	.247/7.633	.292/6.591	.290/5.869	.294/5.352	.301/4.542	.294/3.871	
	.331/10.228	.351/7.923	.348/7.043	.350/6.371	.354/5.342	.362/4.767	
	.415/12.824	.409/9.232	.406/8.217	.407/7.408	.407/6.142	.430/5.662	
	.499/15.419	.468/10.564	.464/9.391	.463/8.428	.460/6.941	.497/6.544	
	.561/17.335	.526/11.873	.522/10.565	.519/9.447	.513/7.741	.565/7.440	
	.621/19.189	.585/13.204	.581/11.759	.579/10.539	.566/8.541	.632/8.322	
	.682/21.074	.658/14.852	.654/13.237	.659/11.995	.680/10.261	.700/9.217	
	.736/22.743	.739/16.680	.735/14.877	.739/13.451	.742/11.197	.767/10.099	
	.809/24.998	.821/18.531	.817/16.536	.819/14.908	.830/12.525	.835/10.995	
	.884/27.316	.902/20.359	.899/18.196	.899/16.364	.910/13.732	.902/11.877	
	.930/28.737	[c].977/22.052	[c].973/19.694	[c].974/17.729	[c].975/14.713	[c].973/12.812	
	[c].975/30.128						

[a]Unsteady-pressure data obtained for these three outboard chords.
[b]In situ transducers used for calibration.
[c]Different from the corresponding orifice on upper surface.

Table 2. Location of Wing Accelerometers

Accelerometer number	x, in.	y, in.
1	19.17	22.78
2	30.06	22.78
3	38.85	61.52
4	47.35	61.52
5	49.25	82.00
6	57.43	84.10
7	54.19	91.72
8	60.96	92.00
9	61.95	107.00
10	67.65	107.00

Table 3. Summary of Unsteady-Pressure and Dynamic-Deflection Test Program

Point number	Mach number	Dynamic pressure, psf	Angle of attack, deg	δ (mean), deg	δ (amplitude), deg	Oscillation frequency, Hz
892	0.60	100	0	0	1	5
893	.60	100	0	0	2	5
894	.60	100	0	0	3	5
895	.60	100	0	0	1	15
896	.60	100	0	0	2	15
897	.60	100	0	0	3	15
898	.60	100	0	0	1	20
899	.60	100	0	0	2	20
900	.60	100	0	0	3	20
902	.60	100	2	0	1	5
903	.60	100	2	0	2	5
904	.60	100	2	0	3	5
905	.60	100	2	0	1	15
906	.60	100	2	0	2	15
907	.60	100	2	0	3	15
908	.60	100	2	0	1	20
909	.60	100	2	0	2	20
910	.60	100	2	0	3	20
869	.70	100	0	0	1	5
870	.70	100	0	0	2	5
872	.70	100	0	0	3	5
873	.70	100	0	0	1	15
874	.70	100	0	0	2	15
875	.70	100	0	0	3	15
876	.70	100	0	0	1	20
877	.70	100	0	0	2	20
878	.70	100	0	0	3	20
880	.70	100	2	0	1	5
881	.70	100	2	0	2	5
884	.70	100	2	0	3	5
885	.70	100	2	0	1	15
886	.70	100	2	0	2	15
887	.70	100	2	0	3	15
888	.70	100	2	0	1	20
889	.70	100	2	0	2	20
890	.70	100	2	0	3	20

Table 3. Continued

Point number	Mach number	Dynamic pressure, psf	Angle of attack, deg	δ (mean), deg	δ (amplitude), deg	Oscillation frequency, Hz
837	0.80	100	0	0	1	5
838	.80	100	0	0	2	5
839	.80	100	0	0	3	5
840	.80	100	0	0	1	15
841	.80	100	0	0	2	15
842	.80	100	0	0	3	15
843	.80	100	0	0	1	20
844	.80	100	0	0	2	20
845	.80	100	0	0	3	20
826	.80	100	2	0	1	5
[a]827	.80	100	2	0	2	5
828	.80	100	2	0	3	5
829	.80	100	2	0	1	15
830	.80	100	2	0	2	15
831	.80	100	2	0	3	15
832	.80	100	2	0	1	20
833	.80	100	2	0	2	20
834	.80	100	2	0	3	20
808	.85	100	0	0	1	5
809	.85	100	0	0	2	5
810	.85	100	0	0	3	5
811	.85	100	0	0	1	15
812	.85	100	0	0	2	15
813	.85	100	0	0	3	15
814	.85	100	0	0	1	20
815	.85	100	0	0	2	20
816	.85	100	0	0	3	20
817	.85	100	2	0	1	5
818	.85	100	2	0	2	5
819	.85	100	2	0	3	5
820	.85	100	2	0	1	15
821	.85	100	2	0	2	15
822	.85	100	2	0	3	15
823	.85	100	2	0	1	20
824	.85	100	2	0	2	20
825	.85	100	2	0	3	20

[a]No pressure data available.

Table 3. Continued

Point number	Mach number	Dynamic pressure, psf	Angle of attack, deg	δ (mean), deg	δ (amplitude), deg	Oscillation frequency, Hz
993	0.80	105	0	0	1	5
995	.80	105	0	0	2	5
996	.80	105	0	0	3	5
997	.80	105	0	0	1	15
998	.80	105	0	0	2	15
999	.80	105	0	0	3	15
1001	.80	105	0	0	1	20
1002	.80	105	0	0	2	20
1001	.80	105	0	0	3	20
984	.80	105	2	0	1	5
985	.80	105	2	0	2	5
986	.80	105	2	0	3	5
987	.80	105	2	0	1	15
988	.80	105	2	0	2	15
989	.80	105	2	0	3	15
990	.80	105	2	0	1	20
991	.80	105	2	0	2	20
992	.80	105	2	0	3	20
577	.60	200	0	0	1	5
578	.60	200	0	0	2	5
579	.60	200	0	0	3	5
580	.60	200	0	0	1	15
583	.60	200	0	0	2	15
584	.60	200	0	0	3	15
585	.60	200	0	0	1	20
586	.60	200	0	0	2	20
587	.60	200	0	0	3	20
590	.60	200	2	0	1	5
[a]591	.60	200	2	0	2	5
592	.60	200	2	0	3	5
593	.60	200	2	0	1	15
	.60	200	2	0	2	15
	.60	200	2	0	3	15
[b]598	.60	200	2	0	1	20
599	.60	200	2	0	2	20
600	.60	200	2	0	3	20
528	.70	200	0	0	1	5
529	.70	200	0	0	2	5
530	.70	200	0	0	3	5

[a]No pressure data available.
[b]No deflection data available.

Table 3. Concluded

Point number	Mach number	Dynamic pressure, psf	Angle of attack, deg	δ (mean), deg	δ (amplitude), deg	Oscillation frequency, Hz
531	0.70	200	0	0	1	15
533	.70	200	0	0	2	15
534	.70	200	0	0	3	15
535	.70	200	0	0	1	20
536	.70	200	0	0	2	20
537	.70	200	0	0	3	20
538	.70	200	2	0	1	5
539	.70	200	2	0	2	5
540	.70	200	2	0	3	5
541	.70	200	2	0	1	15
542	.70	200	2	0	2	15
543	.70	200	2	0	3	15
544	.70	200	2	0	1	20
545	.70	200	2	0	2	20
546	.70	200	2	0	3	20
506	.80	200	0	0	1	5
507	.80	200	0	0	2	5
508	.80	200	0	0	3	5
509	.80	200	0	0	1	15
510	.80	200	0	0	2	15
511	.80	200	0	0	3	15
512	.80	200	0	0	1	20
513	.80	200	0	0	2	20
514	.80	200	0	0	3	20
[a]518	.80	200	2	0	1	5
[a]519	.80	200	2	0	2	5
520	.80	200	2	0	3	5
521	.80	200	2	0	1	15
522	.80	200	2	0	2	15
523	.80	200	2	0	3	15
524	.80	200	2	0	1	20
525	.80	200	2	0	2	20
526	.80	200	2	0	3	20
937	.85	200	0	0	1	5
938	.85	200	0	0	2	5
939	.85	200	0	0	3	5
940	.85	200	0	0	1	15
941	.85	200	0	0	2	15
942	.85	200	0	0	3	15
943	.85	200	0	0	1	20
944	.85	200	0	0	2	20
945	.85	200	0	0	3	20

[a]No pressure data available.

Table 4. Measured Unsteady-Pressure Data

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Table 4. Continued	Table 4. Continued	Table 4. Concluded

Table 5. Measured Wing Dynamic-Deflection Data

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Figure 1. DAST ARW-2 model mounted in wind tunnel.

Figure 2. Sketch of complete wind tunnel model. All dimensions are in inches.

Figure 3. Sketch of wing planform. All dimensions are in inches.

Figure 4. Wind tunnel test conditions.